

Techniques in medical education

Problem-based learning in medicine: an introduction

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Summary

Problem-based learning is an innovative and challenging approach to medical education – innovative because it is a new way of using clinical material to help students learn, and challenging because it requires the medical teacher to use facilitating and supporting skills rather than didactic, directive ones. For the student, problem-based learning emphasises the application of knowledge and skills to the solution of problems rather than the recall of facts. It is an approach much favoured by curriculum planners in new and more progressive medical schools. This paper describes the educational basis of problem-based learning and gives an example of how it operates in undergraduate medical education.

Keywords: problem-based learning, education, techniques

An example of a PBL problem from the University of Limburg at Maastricht

A 55-year-old woman lies crawling on the floor in obvious pain. The pain emerges in waves and extends from the right lumbar region to the right side of the groin and to the front of the right leg.

Box 1

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Accepted 15 February 1995

What is problem-based learning?

Problem-based learning (PBL) is an important and widely discussed development in medical education and forms the basis of the curricula of many newly established medical schools throughout the world. A number of universities in the UK (including Liverpool¹) are incorporating the principles of PBL into their own curricula. It is mainly used in the undergraduate setting and, as a result of recent General Medical Council recommendations,² many new graduates will have experienced it in one form or another.

PBL is concerned with both what students learn and how they learn it,³ and uses specially prepared problems, usually written cases derived from clinical experience, as the basis of the curriculum. Box 1 shows an example of a case developed at the University of Limburg in Maastricht in The Netherlands. Students may use this case to stimulate their learning of anatomy and physiology during the early parts of their course by finding explanations for the source, distribution and underlying physiological process of the pain. Box 2 shows a case developed at the University of Liverpool for fourth year students during an oncology block. The approach used at Liverpool encourages students to consider their learning issues as elements of four curriculum themes (box 3).

PBL is an approach first used in medicine but which can now be found in many teaching settings including architecture, nursing, engineering and social work. The method uses tutorial discussion groups supplemented by traditional teaching methods to stimulate active learning on the parts of students. The problems chosen are derived from clear course objectives and are sensitive to the level of sophistication of the student at different stages of training. PBL started in North America where medical teachers, concerned about curriculum overload and inappropriate teaching methods, shifted the emphasis of the undergraduate curriculum away from individual disciplines such as biochemistry, anatomy and physiology towards an integrated approach involving students in problem solving and independent learning, often from the first term.⁴ Critical reflection on evidence and about its use in working on problems is at the heart of PBL and is a central requirement for effective learning.⁵

Implications of PBL for medical teachers

For the traditional medical teacher, PBL means less lecturing but more student contact in the form of small group work and self-directed learning. It means that lectures do not need to be prepared and updated each year but it does call for different skills, particularly those of group leadership. The design and development of PBL trigger material takes time and planning that should not be underestimated especially when starting afresh. It also requires careful discussion with medical teachers and organisers to ensure that the material is relevant, practical and clearly related to objectives for teaching. Such discussions can be very fruitful in developing shared understanding between, for example, basic science, hospital and community teachers.

PBL encourages the learner to work on problems for himself. There is often initial surprise at not having to memorise tracts of isolated information and discomfort at the prospect of discovery rather than passive learning. The challenge of integrating experiences, previous knowledge, skill and activities with new knowledge and using this to solve clinically related problems, is stimulating for many students and is most appropriate in a community setting.⁶ PBL offers the opportunity to integrate psychosocial elements into the student's thinking about medical problems helping to develop 'three dimensional' thinking, although research at Maastricht suggests that students need clear 'psychological triggers' in such cases.

A PBL case from the University of Liverpool

Maria is 50 years old. She has two daughters aged 18 and 23, is divorced and is looking after her 82-year-old mother. She was called for screening by the National Health Service Breast Screening programme last week and was recalled to the assessment clinic. She has been told that she has a suspicious lesion in the left breast.

Box 2

Four themes of the Liverpool curriculum

- structure and function in health and disease
- individuals, groups and society
- professional values
- public health and epidemiology

Box 3

The 'seven steps' used in PBL tutorials

- clarify terms and concepts which are not clear
- define the problem/problems
- analyse the problem (brainstorming)
- list possible explanations
- formulate learning objectives and set priorities
- look for additional information outside the group
- report back, synthesise and test information

Box 4

PBL in action

*'The starting point for PBL is a problem, a query or a puzzle that the learner wishes to solve'*⁷

There are a number of practical applications of PBL in action.^{8,9} An example of a common form is given below in which a series of weekly cases of increasing complexity act as a central resource for tutorial discussions and for self-directed study. The cases are supplemented by regular lectures, lab sessions, conferences, computer-aided learning, visits and projects in the hospital or community as appropriate. This wide experience offers a variety of perspectives on the main instructional theme of the week and encourages the student to think across the subject rather than focusing on single or solitary aspects of it.

THE PBL TUTORIAL

The tutorial discussion is the engine that drives PBL. Each week two tutorials take place, one at the beginning to set the theme in action and one towards the end as a follow-up session. There may also be periodic 'time-out' sessions (say once every two weeks) to check on progress, spot problems and deal with group interaction issues. The process is varied but usually groups of six or seven students work together with a tutor. The tutor need not be a subject specialist as he or she is not called on to act as a resource. Instead the tutor acts as a guide and helper as the students progress through the discussion and decision making required to find a solution to the problem presented. The group usually elect a note-taker responsible for recording the main items of the discussion on a board or flip chart. These items are used to define the learning activities that the group will subsequently undertake, whether alone or together, before the next meeting. A summary of the topics covered provides a useful synopsis of the work carried out by the group over a term¹⁰ and can be used in curriculum evaluation.¹¹

The tutor starts the session with a presentation of the problem. This may take the form of a written case, a videotape or an audio recording. Analysis of the problem then follows a pattern often described as the 'seven steps' (box 4).

Students are expected to organise their thoughts (about the problem) and to attempt to identify the general nature of the problem and the factors involved. After brainstorming on the underlying causes, mechanisms, and possible solutions, areas of uncertainty or ignorance are recorded on a flip chart. The group is then encouraged to examine the recorded suggestions in greater detail. During the discussion, further questions that the students do not understand or do not know about emerge and these are also recorded on the flip chart. Before the end of the session the tutor helps the students to concentrate on the questions that are especially important at their current stage of training. The students then decide which of the questions they will follow up, individually or as a group.

At the second session the students are encouraged to reflect on what they have learned by answering the questions left on the flip chart from the earlier session. They explore each others answers to the questions and consequently, teach themselves and compare their own performance with that of their peers. The new knowledge and understanding acquired in this process is applied to solving the original problem and the earlier hypotheses considered, rejected or refined accordingly. Definitive resolution of the problem is not necessary, especially in the early part of the course.

In seeking the answers to problems raised during the tutorial discussions, the students learn how to obtain information from various sources including experts, libraries and computer resources and in the tutorial at the end of the week they learn how to question information critically. The method encourages active use of what has been learned and provides instant feedback on how well newly acquired information has been assimilated.

The group are able to develop their own questions about the problem and to seek their own answers. This new information is then integrated with existing personal knowledge and with the knowledge of the group in trying to formulate a solution. Observers of PBL sessions emphasise that the atmosphere should be, and usually is, non-competitive with students working together to find solutions. Other arrangements are possible, for example, three tutorials covering a two-week module (as at the Universities of Liverpool and Toronto¹²) or a single 'unfolding' case covering three tutorial meetings a week for a four-week period as in the dental course at the University of Texas at Austin.¹³ At the University of Linköping in Sweden, students have a choice of cases during each block, each case revealing different aspects of core knowledge.

Does PBL work?

Many teachers see PBL as a method for developing active and independent learners, creative and divergent thinkers and good communicators.¹⁴ They hope

the product of a problem-based curriculum will be a doctor well versed in group problem-solving, capable of working well on his or her own, competent at using literature and statistical databases to retrieve information and confident in his own professional ability. But is this the case? Evaluation of PBL produces equivocal results. A review of over 100 papers published between 1972 and 1992,¹⁵ found that, compared to conventional teaching, PBL was more enjoyable and supportive and that graduates who had experienced it 'performed as well, and sometimes better, on clinical examinations, and were more likely to enter family medicine'. The review also found that medical teachers enjoyed teaching using PBL. The authors draw attention to the need for further work determining the costs of PBL compared to conventional teaching and to its effects on students' reasoning processes suggesting that, for some students, important gaps in knowledge might occur.

Using psychometric methods, some differences have been suggested between students, with a tendency for those learning within a traditional curriculum to score more highly on measures of superficial learning whilst those in PBL-based courses score better on measures of 'deeper' learning of understanding.¹⁶ Norman and Schmidt¹⁷ reviewed the experimental literature concerning the psychological basis of PBL and concluded that, whilst general problem-solving skills were not enhanced by a PBL course, the knowledge learned during such a course was better retained. They also suggested that integration of basic science into clinical concepts and the use of knowledge in the clinical context was improved and that both intrinsic motivation to learn and self-directed learning skills were substantially enhanced by PBL courses. They report that students in a PBL environment find the 'learning environment more stimulating and humane than do graduates of conventional schools'.

Comparisons between students in PBL and conventional courses are difficult because conventional testing instruments are geared towards traditional teaching methods and so test knowledge recall rather than application and problem-solving. Perhaps the most significant finding is the high levels of enjoyment and satisfaction recorded by both teaching staff and students in problem-based programmes; compared with current levels of dissatisfaction experienced by students in conventional curricula¹⁸ this finding alone makes an exploration of the potential of PBL essential.

What has PBL to offer undergraduate education?

*PBL 'places the responsibility for learning in the hands of the students . . .'*¹⁹

PBL works best within a planned curriculum with clear learning objectives determined for each stage. Problems are selected (or specially written) to give the student an opportunity to master these objectives, even if the case itself is not 'solved'. Because of the opportunities to integrate knowledge and skills from across a number of disciplines, PBL is a very useful teaching strategy for integrated undergraduate teaching, especially as exposure to learning in primary care increases.²⁰ PBL is a good starting point for shared learning: for example, students in Linköping spend half of their first year in multi-disciplinary groups of medical students, physiotherapy students, laboratory technicians and other professions allied to medicine. The development of a PBL curriculum calls for otherwise isolated professionals to work together to prepare cases and material relating to the core of their teaching and to act as tutors in subsequent programmes. The cases used to generate PBL activity need not be written and, in the clinical years, random case analysis of the materials seen by students themselves is an excellent tool for identifying areas of potential for learning.²¹ Simulated patients (or videotapes) presenting, for example, the typically complex material a general practitioner is likely to encounter, may also be used. PBL lends itself to the small group environment and group project work²² may also be a useful introduction to the use of PBL.

PBL has the potential to be a stimulating and challenging way of teaching and of learning about medicine. The use of small group work, self-directed learning, peer support and feedback and the development of critical thinking is an ideal preparation for learning as a postgraduate. Its introduction and development takes time and co-ordination but the resulting materials and programmes promise lasting benefits.

Summary points

- students learn by analysing selected clinical problems
- students work in tutorial groups recording key areas for learning
- learning is active and student-directed
- self-directed learning skills are developed and enhanced
- teachers guide and facilitate rather than direct
- discovery and application of knowledge emphasised over recall
- assessment focuses on clinical reasoning and self-directed learning as well as recognition and recall of facts

Box 5

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NEWS

FELLOWSHIP OF POSTGRADUATE MEDICINE

Dr MWN Nicholls, President of the Fellowship of Postgraduate Medicine, presided at a dinner held on Wednesday 1 March 1995 at the Athenaeum in London to mark the retirement of Dr Barry Hoffbrand as Editor of the *Postgraduate Medical Journal*. Dr Hoffbrand was editor of the Journal from 1981 to 1994, having previously been assistant editor.

Among those present were Dr Marina Hoffbrand, and past and present members of the Council of the Fellowship of Postgraduate Medicine and of the editorial board of the *Postgraduate Medical Journal*. Dr Hoffbrand was presented with an engraved silver salver and a cheque.

CONTINUING MEDICAL EDUCATION IN EUROPE

A conference on 'Continuing medical education in Europe: the way forward through European collaboration' was held on 30 and 31 March 1995. The conference, organised by the Fellowship of Postgraduate Medicine, together with other organisations interested in medical education, was held at the Royal College of Physicians in London and attended by nearly 200 delegates and speakers from Europe and the US, Canada and Australia.

The proceedings will be published as a supplement to the *Postgraduate Medical Journal* later in the year.